CLCS Operations and Maintenance Philosophy

Purpose

The CLCS Operations and Maintenance Philosophies are designed with the primary goal of providing CLCS resources at the highest operational availability obtainable, in order to meet current and future space vehicle manifest requirements. Based upon the existing CCMS O & M philosophies and “lessons learned” in the current system, the CLCS Operations and Maintenance Philosophies operate in a symbiotic relationship in order to achieve this goal. This tightly integrated approach provides the basis for a safe, reliable, and affordable Control, Launch and Checkout System.

CLCS "Behind-The Scenes" Organizational Overview

The “Behind-The-Scenes” organizational overview provides a framework for understanding the interrelationships between the CLCS infrastructure support team (the old CCMS I “back room”) and the flow-related “front room” team, and the subsequent mapping of personnel to CLCS functional requirements. In CLCS, the line between the front and back rooms has become less well defined. However, even in this new environment, it is clear that the back room team still provides the support services, to allow the flow-related team the ability to carry out their tasks. The activities associated with these “infrastructure” tasks, in providing a successful test platform, have largely been invisible to the front room. This overview attempts to provide a measure of insight into back room activities, and the CLCS functions and personnel associated with those activities. Other factors that serve to define the operational and physical boundaries of the CLCS hardware, include issues such as “span of control” authority, and security and network configuration control during major tests. The operational tasks, CLCS functions, and manpower associations are detailed herein.

A Master Function is logically associated with a single Test Configuration (CLCS set) that is supported by CLCS O & M personnel. These personnel consists of CLCS Test Conductor(s), CLCS Test Engineer(s), and CLCS System Operator(s). The CLCS Test Conductor provides the authority for any configuration changes necessary to support the test in progress, and is the single point-of-contact between the front room testing and all back room activities. Should a configuration change be required, CLCS System Operators are tasked by the CLCS Test Conductor to invoke the Activity Management task, in order to perform the requested changes. The Activity Management task is logically associated with, and resides within, the physical boundaries of an Operations Control Room (OCR) and provides infrastructure support, monitoring and software load control to ensure hardware resources are available to the Master Function and to the tests, at large. Additionally, the CLCS Test Conductor is responsible for coordinating and monitoring all troubleshooting and maintenance activities being performed by CLCS Test Engineer(s), that may impact the test in progress.

The Maintenance Monitor Function also resides within the OCR and has two distinct functions. Operationally, it receives health and/or status data from the Master Function and Activity Management tasks, as well as network performance and health data from the Network Manager Function. The Maintenance Monitor Function uses this data as a basis for advisory recommendations to the Master Functions within its support area, and as input to the fault decision tree analysis required for off-line maintenance actions. In a non-operational (off-line) environment, or when specific resources are released from operational support, the Maintenance Monitor Function becomes the platform for remote diagnosis of failed resources. In this capacity, the operational data is melded with diagnostic results and off-line failure databases to provide a recommended repair solution. It is supported on an "as needed" basis by maintenance personnel. In this regard, the on-line functionality associated with the Maintenance Monitor Function must be provided while unmanned.

In addition to the network configuration and control, the Network Manager Function provides the necessary OCR/set isolation required for specified tests (i.e., S0007). This ensures that specific "outside interests" are not able to gain access to the CLCS set during critical or hazardous testing. This function also provides health and performance data to the Master and Maintenance Monitor Functions, to support a smooth resource reconfiguration as required. It is an infrastructure tool that is dedicated to the OCR in which it supports. Like the Maintenance Monitor Function, it is not staffed continually, and as such, must function autonomously.

As the Shuttle Data Center provides the software load resources to each OCR, the health and status of the SDC must be available to all Master Functions within each OCR to support any changes to a Test Configuration that may be required.

CLCS Operations Philosophy

Introduction

The CLCS Operations Philosophy is structured around two distinct phases: Startup Operations and Sustaining Operations. Startup Operations are tasks and procedures performed in order to prepare a group of CLCS resources to support testing of a Test End Item (TEI) or simulated component, while Sustaining Operations are tasks and procedures performed to insure the required CLCS resource operability, once those resources are initialized and functioning. Although each phase has unique tasks, they both utilize several common functions. These phases are categorized within the following structure:

I. Startup Operations

A. Initial Hardware Configuration Setup.

1. Flow Zone/Control Zone/Front End Zone Checks *(Physical Security, Pre-Ops Setups, Manual Ops. Setups)*
2. Network Configuration/Discovery Process *(ORT-2)*
3. Workstation Assignments/Associations

B. Startup of System Integrity Monitoring.
(Health and Status Monitoring during Software Load Process)

C. Software Load and Distribution to Hardware platforms.
($INST, $PRELD)

1. Scheduled Operating System Loading or Operating System Verification within the hardware platforms.
2. Scheduled System and Application Software loading.
3. Verification of Operational Readiness to Support Operations.
(Non-destructive On-line Diagnostics, ORT-4, ORT-5)

E. Initialization of Test Configuration. *($CLAI, Facility Verification, A-DA)*

1. Initialization and Startup of System Processes
2. Verification of proper CLCS set connectivity to Test End Item.
3. Startup of Data Acquisition and Processing

II. Sustaining Operations

A. Monitoring of Set Resources.
(System/Subsystem Integrity, $SYS, $HWMON, AA00x)
1. Health Monitoring of System Resources.
2. Error Monitoring and Reporting of Fault conditions.
3. System Performance Monitoring.
4. Subsystem State Tracking. *(Checkpointing)*
5. HIM Command Data Verification. *(Switch Scan)*

B. Redundancy Management. (Failure Mode Detection & Recovery)
(Controlling/Non-Controlling System Integrity, $CLAI, SLP50)
1. Monitor, Detect, and Automatic Reconfiguration of Critical and "Pseudo" Critical System Resources.
2. Subsystem Resource State restoration/re-synchronization.
3. Event-Driven Responsible System Reconfiguration.
4. Redundancy Management process itself, is redundant and monitored.

C. System Resource Reconfiguration during Ongoing Operations.
("As Required" Reconfiguration) ($PRELD, $UPDATE, $PATCHER, $CLAI)

1. Reconfiguration/Reload/Reinitialization/Reactivation of System Resources as a result of failures, resource reallocation, or required maintenance.

2. Operating System/System/Application Software configuration changes as a result of software upgrades/changes.

D. Fault Detection/Fault Isolation, Performance Tuning, and System Maintenance tool utilization in an On-line/Off-line environment.
(Data Retrievals, System Utilities/Debuggers, Analyzers, Expert Systems, Predictive Advisories, All Diagnostics, ORT.)

E. Verification/Validation of restored System Resources upon completion of corrective actions. *(All Diagnostics, ORT, $LIBRARY, $PRTLIB)*

To achieve these tasks, the CLCS Operations Philosophy operates in a modular and flexible environment with easy access to system resources. All configurations, loading, initializations, and monitoring of resources within all sets or subsets are managed from the Master Function. The task of performing and managing the software loading of CLCS resources is performed by the Activity Management task, which is invoked on demand by the Master Function.

All resource monitoring and redundancy decision processes are performed by a System Integrity task that executes within the Master Function. The System Integrity task controls redundant switchovers, and monitors the health and status of all system resources supporting a test configuration in a CLCS set. If an OCR is partitioned into several sets (i.e., multiple tests within the same physical Operations Control Room), then each set contains a Master Function. The Master Function has the capability to be associated with any Workstation within the Flow Zone that is a member of the test configuration. The Master Function is, itself, redundant in order to ensure continued health and status monitoring and redundancy management during a test.

The Shuttle Data Center (SDC) is the central point of distribution and storage of all released software (system and application) required to load a CLCS set or individual resource. The Activity Management task interfaces to the SDC in order to provide required information as to

which resource(s) are to be loaded. Additionally, the SDC provides the storage of recorded data from the CLCS set resources, along with software to perform data retrievals.
Since the CLCS architecture is composed of several networks, the Network Management Function is used to control and monitor the CLCS networks and their interface to other networks. This function intercommunicates with the Master and Maintenance Monitor Functions to provide the necessary level of control, notification and maintenance actions to ensure maximum set availability.

Expert applications, support tasks, and utilities residing across different platforms are key to supporting various Operations and Maintenance functions (error analysis, memory dump analysis, etc.). Expert/predicative software provides advisory recommendations to the operational arena and fault/decision analysis for maintenance functions. System wide documentation that is available in electronic format on line, and access to databases and other information systems (PRACA, IOS, PTS, etc.), provides support for all areas of operations and maintenance.

Common Functions

Common processes within both Startup and Sustaining Operations are the Master Function and the Network Manager Function. The Maintenance Monitor Function, while not strictly an operational tool, is nevertheless, a common function in that, it receives operational data for use in determining appropriate maintenance actions. These combined functions provide the necessary interfaces to both Operations and Maintenance tasks, in order to manage and maintain CLCS system resources. The Maintenance Monitor Function is discussed in the Maintenance Philosophy section.

Master Function

System Integrity Task

The primary job of the Master Function is to monitor the health and state of a Test Configuration (set). This is accomplished by the System Integrity task within the Master Function. The System Integrity task performs the health and status monitoring of all resources (subsystem and network resources) allocated to a particular test configuration, and performs the redundancy management of all active/standby subsystems. It validates subsystem health, and based on system configuration, commands active/standby switchovers for failed redundant components. The System Integrity task sends messages to the workstation(s) associated to the Master Function for notification and displaying of failed subsystems, or significant events that occur within the set. Selective messages are also sent to all subsystems in the affected set, to the SDC for recording, and to the Maintenance Monitor Function for performance/fault analysis. Additionally, the System Integrity task reports unexpected changes to subsystems (GSE bus errors, PCM format changes, loss of PCM data, etc.). Selective informational and error messages that are received from Subsystem Integrity tasks within all set resources, are processed by the System Integrity task and are also routed to the Maintenance Monitor Function for fault analysis. Redundancy also exist for the System Integrity task, which executes within a separate hardware platform. A graphical user interface provides the capability to monitor both overall system health and status, or detailed subsystem health and status. The network or subsystem status display is operator selectable to the desired level of detail. For example, the operator can select to see a subsystem's peripheral error counts, or the overall subsystem status. The health and status of each subsystem is also recorded in the SDC.

Activity Management Task

The loading of software to resources within a set is managed by the Activity Management task. When invoked by the Master Function, this task provides the capability to load an entire CLCS set, a specified group of resources within a set, or an individual resource.

When an entire set is to be loaded, a test configuration (which consist of an associated collection of software and hardware resources needed to support a test), is pre-defined and stored in a centralized storage location within the SDC. The software to be loaded consists of the operating system, system applications and user engineering applications, as well as supporting tables, etc., that make up the test configuration software package (TCID). The software test package is built by the software development process and placed under configuration control prior to being loaded into an operational environment. When a configuration is needed for testing, operations personnel retrieve the specific configuration and, upon verification of the desired configuration, initiates the autonomous loading of the specified hardware. The Activity Management task associates a group of gateways, processors, servers, etc., with a software test package as pre-defined by the Test Configuration, in addition to a group of user positions (workstations) to support the test configuration. The Activity Management task monitors the progress of the load process, while the SDC loads the hardware and provides data integrity and verification mechanisms (CRC, checksums, etc.) to insure proper subsystem load and configuration. Upon successful loading and initialization of the set, the CLCS users access their software, specific to each engineering discipline, via user logon.

The Activity Management task also provides the capability to request a change (load or reload) to a test configuration (in real time) in response from a request from the Master Function. Additionally, the Activity Management task can obtain integrity and version/revision information of software currently stored on a server or hardware platform, and compare this information to pre-defined test configuration parameters.

Operational Readiness Test Task

The Master Function also supports an Operational Readiness Test task, which provides the capability to safely test system resources. These tests provide a “level of confidence” that a resource is properly configured and ready to support in an operational environment. This task exercises the software and hardware interfaces which are utilized when the resource is functioning in an on-line (operational) environment. Specific restrictions are incorporated such that, testing of resources that are directly connected to a Test End Item, do not adversely effect the Test End Item itself.

Checkpoint Task

An additional task that the Master Function supports the Checkpoint task, which tracks and/or restores subsystem state information to a subsystem. The Checkpoint task provides ongoing (continuous) and snapshot (demand) state information request capabilities, along with interfaces to other task that are utilized to restore a subsystem to a specified state configuration.

Hardware Interface Module (HIM) Scan Interface Task

Finally, the Master Function supports the Hardware Interface Module (HIM) Scan Interface task. This task, upon operator command, interfaces with selected GSE Gateways to request command stimulus values from a specified HIM. The task provides updates to the stimulus values to the necessary set resources, and displays updated HIM command stimulus data values to the associated Master Function’s workstations for operator notification.

Network Manager Function

The Network Manager Function is responsible for the management, configuration, and monitoring of all network components for all networks supporting the CLCS architecture. A Network Manager Function is provided within each OCR to manage these tasks. It provides health and performance data to all Master Functions (for the System Integrity and Activity Management tasks) within its OCR, to the Maintenance Monitor Function for load balancing and system tuning, and to the SDC for notification. As an integrated control and monitoring platform, it interfaces with commercial sniffers and analyzers to provide additional insight into system anomalies and performance bottlenecks.

Other Related Functions and Tasks

Subsystem Integrity Task

A Subsystem Integrity task is incorporated within all subsystems, and interfaces with the System Integrity task executing within the Master Function. The Subsystem Integrity task provides health and status information to the System Integrity task for health monitoring and redundancy management decisions, and also records the health and status data to the SDC. Additionally, the Subsystem Integrity task routes error and informational messages to all workstations associated with that subsystem and, on a selective basis, to the associated Master Functions within the set. Each message is tagged as to the set and subsystem that the message originated from, and the time and date of the message occurrence. The message also contains an identifier of the software component originating the message.

CLCS Maintenance Philosophy

Introduction

The CLCS Maintenance Philosophy is structured around a three tiered concept: Organizational, Intermediate and Depot Level maintenance. To determine the best maintenance approach for each level, an individual Maintenance Plan is developed for all system components. This plan performs a Repair Level and Life Cycle Cost Analysis which specifies where maintenance is done, how maintenance is accomplished at each of the levels, and identifies spares requirements based on these analyses. This thoroughly documented maintenance process will be *ISO 9001* compliant.

At the Organizational or System Level, major assemblies are repaired by removing and replacing Line Replaceable Units (LRU) with functional spares. Generally, an LRU is a circuit card, power supply, network or computer box, printer or other assembly whose repair is not practical within the on-line environment. Disposition of any defective unit removed from the operational environment occurs at the Intermediate Level. Custom hardware is repaired within the Intermediate Level Maintenance Facility (ILMF) located at KSC while Commercial Off The Shelf (COTS) hardware may be repaired at KSC or Returned-To-Vendor (RTV) as determined by the Maintenance Plan. Depot Level maintenance is generally performed by the various COTS vendors but may be performed by ILMF personnel. After receiving COTS hardware from the vendor, and after repairing Custom hardware, ILMF performs a thorough retest/validation of all LRUs prior to returning to stock.

Maintenance Plan

The Maintenance Plan is a document which is developed to provide the most sensible approach to maintenance activities. It provides a method to minimize operation and support costs as related to the total life cycle cost of the system. The plan is driven by the needs of the Shuttle Processing user community and is based on the Operational Availability and Mean-Time-To-Repair requirements at the Organizational Level as defined by the user. It specifies spares stocking levels as well as repair processes for all levels of maintenance for all products. In developing the plan, the following issues are considered:

- complexity of the equipment
- reliability
- operational constraints
- criticality
- schedule
- maintainability
- redundancy
- skills
- training
- vendor support
- replacement costs
- repair/procurement pipeline times
- technical documentation availability and cost
- special tools and test equipment availability and cost
- custom/proprietary component availability and cost
- etc.

As technological improvements occur within the CLCS hardware and as these improvements migrate into the repair processes, the plan evolves to meet those changes. The end result of the Maintenance Plan is a guidepost document which defines a cost effective approach to maintenance at all levels, throughout the life cycle of the program.

Organizational Level Maintenance

Maintenance at the Organizational Level is generally limited to the periodic servicing of equipment through scheduled downtimes, troubleshooting to isolate failed components, and the removal and replacement of LRUs and subsystem assemblies. Other actions may include in-place modifications, calibrations, line validations, and various reverification processes. These actions are accomplished through SFOC contractor maintenance personnel only. Any required vendor support within the CLCS program occurs in off-line environments only.

The emphasis at the Organizational Level is to return any failed hardware to an operational state as soon as possible to meet the Operational Availability requirement of 99 percent. The concept of Hot Spares is one of the methods used to meet this goal. The Minimum Peripheral Test Set (MPTS) is a hardware set located within the Launch Control Center which provides a complement of critical spares which are always in use, running diagnostics, or otherwise being exercised. These Hot Spares are immediately available for installation in a control room during critical tests. For less critical support times, Organizational Maintenance relies upon off-line and on-line diagnostic tools, network health and statistics from the Network Manager Function, and operational data from the Master Functions. These data sources supply operational health, status and test result information to the Maintenance Monitor Function.

Maintenance Monitor Function

The Maintenance Monitor Function is key to the overall success of the on-line environment in meeting the Mean-Time-To-Repair goal of 30 minutes. It is a multi-faceted tool, dedicated for maintenance use, which provides several capabilities. It serves as a central point to run both intrusive and non-intrusive diagnostic testing on all subsystems associated to any Flow Zone within an Operation Control Room (OCR). Intrusive testing is allowed only on subsystems which have been released from operational support. This diagnostic functionality includes the ability to be used in a debug/monitor mode to capture and log system boot up processes for use in diagnosing subsystem failures. It collects time-tagged operational failure and health data from the Network Manager and Master Functions such as system messages, health and status, network statistics, and Operational Readiness Test (ORT) results. It also has access to historical databases such as PTS, PRACA, and IOS as well as other reference data sources such as the Technical Notification System, and the Maintenance Planning Database. These data sources are used in conjunction with the operational and diagnostic failure data, and analysis software, to provide a comprehensive fault isolation tree to guide maintenance personnel through the troubleshooting process. The end result of this function is an ordered list of the most likely failing LRU(s). This expert/predictive software is also used to provide advisory recommendations to the appropriate Master Function concerning components that have not yet failed completely but are operating in reduced or degraded fashion. This ability allows for timely operational reconfigurations of failing hardware. This high level of integration of operational and diagnostic data sources helps manage maintenance actions to provide the highest level of operational availability to the user.

Local Diagnostics

For those systems which are unable to communicate with the Maintenance Monitor Function due to primary network related problems or other faults, local diagnostics which reside on each subsystem are used to fault isolate. These diagnostics are a collection of vendor and custom designed tools, utilities and fault isolation processes. Disk-based, time-stamped error logs and vendor supplied Power On Self Test functions, residing on each subsystem, are used to provide additional insight. Further, connectivity is provided from the console port of each subsystem to the Maintenance Monitor Function to capture boot up failure processes and other messages which may be routed to the port. This ensures that valuable failure data, which would otherwise be lost, is preserved for diagnosis/evaluation.

Network Manager Function

Any network related problems are first detected in the Network Manager Function and then passed to the Master Function to allow operational reconfigurations or work-arounds, and to the Maintenance Monitor Function for analysis. The Network Manager Function provides the control, configuration and monitoring capabilities for the supporting network infrastructure within a CLCS set. As it relates to the Organizational Level maintenance activities, the Network Manager Function provides performance and configuration data to the Maintenance Monitor Function for use in load balancing, system tuning, and both proactive and reactive fault isolation and repair. It also provides the control mechanisms for permitting or limiting access by all external network interfaces. Dedicated hardware monitoring test/injection points strategically located throughout the CLCS hardware sets support the connection and use of commercial network sniffers and analyzers as appropriate to the specific network medium. The Network Manager Function, working in conjunction with these commercial tools and other subsystem components, provides an integrated platform from which to base all control, reconfiguration and repair actions consistent with the CLCS Operational & Maintenance Philosophies.

This broad-based approach to Operational Level maintenance which utilizes system performance and failure data, on-line and off-line diagnostics, and powerful software tools is used to meet the requirement to isolate 90 percent of all non-intermittent faults to the LRU level. The CLCS maintenance methodology, in the on-line environment, differs significantly from the

original CCMS I approach in that operational data sources are tightly integrated with maintenance and repair functions. This feature greatly enhances the overall system availability.

Intermediate Level Maintenance

The Intermediate Level Maintenance Facility provides Intermediate and selective Depot Level maintenance for CLCS equipment using systems and procedures as described in each system's Maintenance Plan. The Maintenance Planning Control Center (MPCC) within the ILMF is the primary Hardware Disposition Area for CLCS hardware and manages the Return-To-Vendor processes. While the repair actions required by some large assemblies may be determined in the MPTS, the disposition process is still managed by the MPCC. Hardware assemblies, repaired by and received from vendors, are verified operational and compatible with existing systems prior to assignment as serviceable spares. Independent verification and validation tasks are performed at the ILMF in a simulated on-line system environment to insure system compatibility of multi-revision level COTS, LRUs and Shop Repairable/Replaceable Units (SRUs). All assemblies are verified prior to use. No LRU or system components will be used in the on-line environment unless they have been verified. This reverification process may occur within the MPTS for large subsystems or for those subsystems which are impractical to transport to the ILMF.

Automatic Test Equipment (ATE) is used to support the repair of any Custom and selected COTS hardware, where practical. Special tools and test fixtures are fabricated, as required, according to the Maintenance Plan to support all repair processes. All products which are routed through the various Intermediate Maintenance Level processes are retested/revalidated prior to returning to serviceable spares.

Depot Level Maintenance

Generally, Depot Level Maintenance will be performed by the vendor at the vendor facility. However, there may be circumstances in which these repair actions may be better accomplished at the Intermediate level Maintenance Facility at KSC. The Return-To-Vendor or Repair-On-Site decisions and considerations associated with COTS products are based on the most cost effective method to maintain these products and include:

- warranty considerations
- proprietary components and/or documentation
- test methods and procedures
- revision level management processes
- limitations of on-site resources such as tools, test equipment and skills

Cost analyses are conducted to determine the benefits of vendor maintenance agreements vs. Per Call maintenance. Cost savings can be realized by the early identification of vendors and the administration of maintenance agreements during the initial procurement phase. However, as this industry is quite dynamic, careful consideration throughout the life of the program must be given to the RTV process, specifically, and to vendor involvement in the space program in general.

Summary

The key to successful maintenance in the CLCS, in which Operational Availability is maximized and repair costs are minimized, is based on three principles: First, the early introduction of maintenance planners in the CLCS development process ensures a "maintenance-

knowledgeable" design team. Second, a thoroughly researched and developed Maintenance Plan which evolves over the life of the program assures that the correct repair/replace decisions are made for all products and subsystems. And third, a relationship in which operational data sources in the on-line environment are tightly integrated with maintenance processes provides significantly improved system utilization. Adherence to these concepts provides an operable, affordable, and maintainable system.

DEFINITIONS

The following definitions are provided in order to more clearly understand the CLCS O & M Philosophies.

Resource - A hardware or software component of CLCS.

Subsystem - A logical CLCS hardware/software entity.

On-line(1) - An environment in which a CLCS resource is actively participating within a set.

On-line(2) - An environment in which CLCS documentation is made available via electronic means.

Off-line - A state in which a CLCS resource is neither operationally participating in, nor associated with a CLCS set.

Intrusive - A state in which a process or event will effect other processes or events. From a CLCS perspective, any process or event which will significantly alter the normal configuration or operation of a CLCS resource which is on-line and operational.

Non-intrusive - A state in which a process or event will not adversely or significantly effect a CLCS resource when it is in an operational and on-line environment.

Operational - The state of a CLCS resource which is configured and initialized in a set, and ready to support.

Non-Operational(1) - From an operations perspective, the state of a CLCS resource which is configured and initialized to a set, but is not ready to support. This state is usually associated to a CLCS resource which is preparing for, or currently executing, some form of an Operational Readiness Test.

Non-Operational(2) - From a maintenance perspective, a CLCS resource which is not associated with a set, or a resource that has been released from operational support for maintenance. The usage of this term is often interchanged with “off-line”.

Function - An entity which performs a task or procedure. It is usually a combination of software and hardware.

Test End Item - A component under test. It is usually flight hardware, Ground Support Equipment (GSE), or a simulation thereof.

Controlling - A state of a process which is actively managing a task. This “class” of function has the capability to function in either a Controlling or Non-Controlling state. In reference to CLCS, the System Integrity task monitors and manages the CLCS system configuration and redundancy management task, when it is functioning as the Controlling task. This scheme is very similar to the Active/Standby philosophy, but is used primarily for software task.

Non-Controlling - A state of a process which is “mirroring” a controlling process. In reference to CLCS, the Non-Controlling System Integrity task (a separate copy executing within a separate hardware platform) also monitors the CLCS system configuration, but does not actively manage the configuration unless the Controlling System Integrity task fails.

Responsible System - A CCMS term which represents a logical grouping of Test End Item functions. Some examples are GLS, Avionics, LOX, etc.

Operational Readiness Test - A custom set of software which exercises and test a CLCS subsystem's hardware and operational software, in order to verify that the subsystem is ready to support testing.

Test Configuration - A logical grouping of software components, which have been associated and configured to support a single or group of Test End Items. The software is then loaded into a CLCS set.

Set - An associated grouping of CLCS hardware and software components**.** It consist of a portion or all of the CLCS resources within an Operations Control Room (OCR). A set is usually comprised of resources from a Front End Zone, Control Zone, and a Flow Zone.

Active(1) - A configuration of a resource, which has the capability to have a logically associated Standby resource. In a general CLCS meaning, a configured CLCS Active resource performs its designated tasks, while its associated Standby resource "mirrors" the majority of the same tasks.

Active(2) - A state of a CLCS resource which is performing operational tasks.

Inactive - A state of a CLCS resource which is not performing operational tasks.

Standby - A configuration of a resource, which has a logically associated active resource. In a general CLCS meaning, a configured CLCS Standby resource "mirrors" the associated Active resource and, upon a failure or authorized request, will "automatically" assume the primary resource's tasks. The intent of this scheme is to prevent the loss of functionality, and is usually employed to resources processing "critical" Test End Item data.

Redundant Pair - The association of an Active and Standby resource.

Primary - A configuration of a resource, which has a logically associated Backup resource. In a general CLCS meaning, a configured CLCS Primary resource performs its designated tasks, while its associated Backup resource is available to assume the Primary's task.

Backup - A configuration of a resource, which has a logically associated Primary resource. In general CLCS meaning, a configured CLCS Backup resource is available, but does not automatically assume the Primary's task, should the Primary resource fail.

Hot Spare(1) - A logical CLCS resource which is on-line and ready to be configured to function as an operational CLCS resource. In a general CLCS meaning, a Hot Spare resource is pre-configured to be able to be reconfigured to function as a replacement for another resource.

Hot Spare(2) - A hardware component (LRU, subsystem assembly, etc.) which is continuously being exercised/tested and made immediately available to maintenance personnel for implementing corrective maintenance action(s).